iB6 & iB12 Integrated Temperature Controller User Guide

smart hot runner solutions

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Precautions

WARNING

Use of this equipment in a manner not specified by the manufacturer may impair protection provided by the equipment.

In addition to presenting a potential fire hazard, high voltage and high temperature can damage equipment and cause severe injury or death. When installing or using this instrument, follow all instructions carefully and use approved safety controls.

Hazardous potentials exist on components inside the controller. Always disconnect AC power to the mainframe when servicing the controller.

Because these temperature controls or associated equipment may not always fail safe, an approved temperature and/or pressure safety control should be used for safe operation.

Turn off power to the controller before cleaning the exterior of the controller.

Failure to observe these precautions can result in exposure to a potentially lethal shock hazard.

All wiring should be done by an experienced technician. The controller and wiring should be installed in accordance with national and local electrical codes. To avoid serious personal injury and damage to equipment, follow all warnings and cautions provided in the hardware setup instructions.

CAUTION

If a controller shows signs of having been damaged during shipping, do not power up or install the controller. Save all packing materials and report any damage to the carrier immediately.

Do not locate this instrument where it may be subjected to excessive shock, vibration, dirt, moisture, oil, or other liquids.

This is a Class A product. In domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

Specified operating ambient temperature is 0 to 50 °C (32 to 122 °F).

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1.1 About this User Guide

This user guide contains all the information needed to configure and operate the iB6 and iB12 Integrated Temperature Controllers.

Wiring diagrams, mounting instructions and other information about installing the hardware are on the installation diagrams shipped with the unit.

1.2 iB6 & iB12 Features and Benefits

1.2.1 Multi-Zone Control with Convenient User Interface

A single iB6 Temperature Controller can provide microprocessor-based control of up to six zones; a single iB12 Hot Runner controller can control up to twelve zones. Zones can be configured individually or all zones can be configured simultaneously.

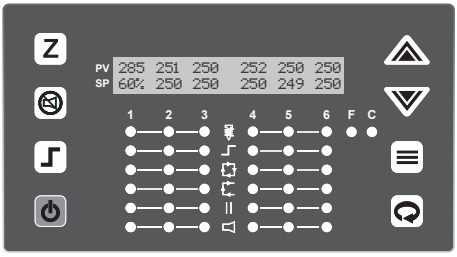
During operation the front panel simultaneously displays the process value and setpoint for every zone. LEDs for each zone indicate the type of control (open or closed loop), output status, alarm status, boost status and standby status. Buttons on the front panel make it easy to change the setpoint, mode and configuration parameter values for one selected zone or all zones.

The front panel also has buttons to:

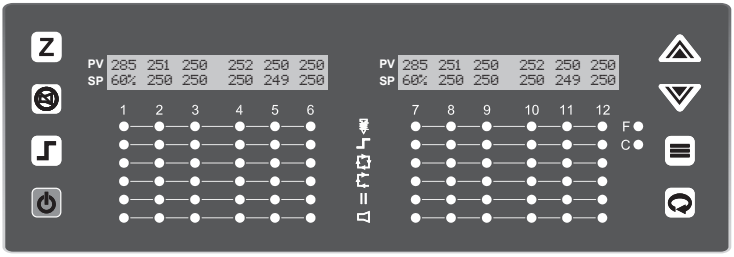
- start the boost for all zones,
- put all zones in Idle or all Idle zones in the Run state,
- silence the audible alarm.

When necessary, access to function buttons on the front panel can be restricted.

→ Refer to Section 7. for details on how to enable or disable functions.



iB6 Operating Display



iB12 Operating Display

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1.2.2 PID Control with Autotuning

When an iB6 or iB12 zone is in Normal (closed loop) mode, Proportional-Integral-Derivative (PID) control is provided. The iB6 and iB12 Temperature Controllers also support Manual (open loop) mode that overrides automatic control. In Manual mode you control the output by entering a fixed output percentage value.[1] A zones transfer from PID to manual is "bumpless" when the process value is within 5 °C (9 °F) of the setpoint.

Using PID control, the controller modulates output power by adjusting the output power percentage within a configurable proportional band. Power is proportionally reduced as the process temperature gets closer to the setpoint temperature.

The configurable derivative action affects the output based on the rate of change of the process value.

The integral action affects the output based on the duration of the process value's variation from the setpoint. In the iB6 and iB12 Temperature Controllers, the integral (reset) action is always equal to six times the configured derivative (rate) action.

An Autotune function is standard on every iB6 and iB12 Temperature Controller. This feature for easy tuning of the proportional and derivative, components of the control algorithm can be initiated every time the controller is powered up, once when the controller is set up regardless of success (and again by changing a parameter value), once only if successful (repeated at each power up until successful), or never.

→ Instructions for tuning the controller automatically and manually are in Section 6.

1.2.3 CompuStep® Soft Start for Heater Bake Out

All iB6 and iB12 Temperature Controllers support the CompuStep® soft start feature, which allows slow dissipation of moisture in heaters by gradually applying power to the heaters. Using this feature helps extend the life of the heaters and the moulds. When a soft start is executed, single cycle bursts start at 5% output power and step up the output 5% every 30 seconds.

- The soft start when the controller is in Normal (closed loop) mode lasts five minutes or until the process temperature reaches 93 °C (200 °F).
- The soft start when the controller is in Manual (open loop) mode continues until the output is the lower of 50% or the target Manual mode output percent.

By default, a soft start will be executed:

- Every time the controller starts (after being taken out of Idle) and the process value is less than 93 °C (200 °F), and
- Every time the controller is returned to Normal (automatic) operation and the PV is less than 93°C (200 °F).

[1] Use of a fixed output percentage is also possible under other circumstances. Configuration parameters let you specify a fixed output to be used as a failsafe action, a different fixed output percentage to be used in standby mode, and another fixed output percentage used during the boost function described in 1.2.4.

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1.2.4 Programmable Boost Function

Every iB6 and iB12 Temperature Controller supports a boost function. For each zone you can use the Boost Config menu to configure a special setpoint (closed loop boost) or a special fixed output percentage (open loop boost) to be used when the boost button is pressed.

The boost function will remain active until:

- the configured boost duration time has expired, or
- you use the mode/enter button to take a zone out of boost mode before the expiration of the boost duration.

1.2.5 Process-Protection Features

Process-protection features are standard on all iB6 and iB12 controllers.

These features include:

- high and low deviation alarms
- high temperature safety limit
- loop break detection
- failsafe operation in case of sensor problems

1.2.6 Security

The iB6 and iB12 front panels include buttons that can be used to change the selected zones setpoint and mode and to boost the output temporarily by a configurable amount. Users who know the Supervisor password can limit access to these buttons on the front panel, plus limit configuration access. (Units are shipped with password protection disabled.)

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1.4 What Happens When You Power Up the Controller

When an iB6 or iB12 Temperature Controller is powered up using the switch on the back, all LEDs and all elements in the LCD display light briefly, and then software versions (of the display and the controller hardware) are displayed.

At the conclusion of the startup process, the process values and setpoints for all zones are displayed. Only the green LED for the display unit of measure (Celsius or Fahrenheit) is lit.

All zone outputs will be off because the unit starts up with all zones in the Idle state.

Briefly pressing the run/idle button on the front of the case puts all zones that are currently Idle in the Run state. (Pressing the button again for at least two seconds puts all zones in Idle.)

In each zones column of LEDs, the green LED in the closed loop or open loop row is lit to indicate the type of control.

The green LEDs in the output row indicate whether the zones outputs are on (LED lit) or off.

→ For more information about the user interface, see the Section 3.

When zones go into the Run state, the effect on each zones output depends on the value of the Startup Mode parameter configured using the Control Config menu.

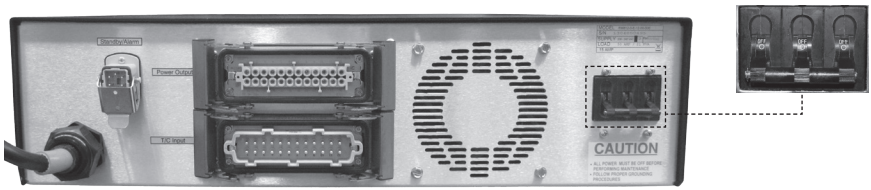
→ Refer to 5.4 for Startup Mode parameter details

2.1 Setup Sequence

The following list summarises the configuration and startup tasks to be accomplished once the controllers are wired as shown on the diagrams shipped with the unit.

→ Refer to Section 5 for information about all configuration parameters, parameter interactions and valid ranges.

1) Turn on the controller using the switch on the back (shown below). When the unit is powered up, the controller goes through its startup sequence (see 1.4), and then the process value and setpoint for every zone (the standard operating display) are shown. **All zones will be Idle (all outputs off).**



If the controller has already been wired to the sensors and heaters, do NOT push the run/idle button on the front of the case until after you have configured the zones and entered custom setpoints. **When zones are taken out of Idle, their outputs may go on unless you change the default parameter values.**

2) Take unneeded zones out of service by setting them to Offline.
   a) Select a zone by pressing the zone selection button Z until only that zones PV and SP are displayed. (Zone numbers are above the column of status LEDs for each zone.)
   b) Access the mode-selection function by pressing the mode/enter button.
   c) Step through the possible modes by pressing the button repeatedly until "Offline" is displayed.
   d) Exit the mode-selection function by pressing the menu-access/exit button. A confirmation message will be displayed briefly and then the PV and SP for the zone will be displayed as "OFF."

3) Notice that the green C (for Celsius) or F (for Fahrenheit) LED is lit. This LED indicates the unit of measure for the process values and setpoints displayed.

   If you want to change the unit of measure used for temperature displays:
   a) With any zone selected, press and hold the menu-access/exit button until the name of a configuration menu is displayed.
   b) Step through the menus by pressing repeatedly until the Display Config menu name is displayed.
   c) To access the Display Units parameter, press. The currently selected unit of measure will alternate with the parameter name on the lower line of the display. Notice that an asterisk ∗ is displayed instead of a zone number. This asterisk indicates that the parameter applies to all zones.

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d) Change the unit of measure by pressing ▲ or ▼.

e) Exit the menu system by pressing and holding ↻ for several seconds. The PV and SP for all zones (except any offline zones) will be displayed in the selected unit of measure. Other temperature values previously entered while a different unit of measure was in use will be converted automatically.

4) If the factory settings listed in subsection 3.6 are not appropriate for your application, you can change a parameter value for one or all zones.

a) To select one zone, press Z repeatedly until only that zones PV and SP are displayed.

To select all zones, press Z repeatedly until the PV and SP for all zones are displayed with asterisks between the PV and SP for zones 3 and 4 (refer to the image below) on an iB6 unit. (On an iB12 unit, asterisks will also be displayed between the PV and SP for zones 9 and 10.)

b) Press and hold ↻ to enter the menu system.

c) Step through the menus by pressing ↻ repeatedly until the name of the menu you want is displayed.

d) Step through the menu items by pressing ☰ until the parameter you want is displayed, alternating with its current value.

e) Change the value by pressing ▲ or ▼. When changing a numerical value, you can hold down an arrow button for fast changes.

f) Exit the menu system by pressing and holding ↻ for several seconds.

Note that the default High [Temperature] Safety [Limit] (a Supervisor parameter) is Off by default. If you want the controller to turn off the output to a zone that exceeds the high limit, change the value of the High Safety parameter.

5) iB6 and iB12 units are shipped with the Supervisor password set to 100, which disables password protection. If you want to limit access to the Superv [Supervisor] Config menu, change the Supervisor password from the default 100. As long as the password is 100, no password will be required to access all functions.

6) Change Normal mode (closed loop) setpoints or Manual mode (open loop) output percentage by selecting a zone, and then pressing ▲ or ▼ to change the setpoint or output percent. A few seconds after you stop pressing an arrow button, the main display (PV and SP) will return.

Tip: If all zones are in the same mode (Normal or Manual), you can select all zones as described above, and then change the setpoint temperature or manual mode output percentage for all zones simultaneously.

7) Autotune all zones that will operate in Normal (closed loop) mode; see Section 6. When Autotuning has been completed successfully for all Normal zones, the controller is ready to use. The appropriate green status LED in the column of LEDs for each zone will be lit:

⟳ for Normal (open loop)

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for Manual (closed loop)

for Standby

If the zone is configured to start up in Idle after the run/idle button has been pressed, no status LED will be lit.

Whenever a zones output is on, its green output LED is lit.

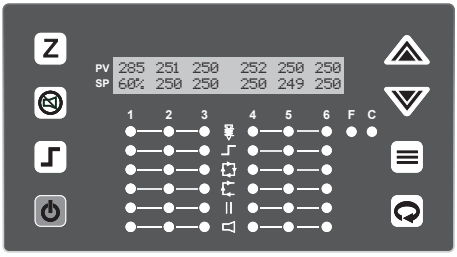
3.1 Overview

During operation, the front panel contains a two-line display that displays the PV (process value) and SP (Normal (closed loop) mode setpoint or Manual (open loop) mode output percentage) for each zone during normal operation. Zone numbers are under the display. PV and SP values are displayed in the unit of measure (degrees C or degrees F) indicated by the lit green "C" or "F" LED.

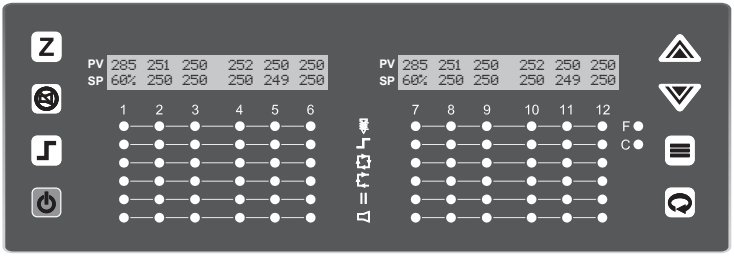
This display can also be used to view and change controller settings as described in subsection 3.5. Parameters are grouped into menus. An overview of the menus is in subsection 3.6

If a zone is in alarm, an alarm code alternates with the SP value.

→ Alarm codes and priorities are listed in Section 4.5



iB6 Operating Display



iB12 Operating Display

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3.2 LED Status and Button Functions

3.2.1 LED Symbols

A column of LEDs for each zone indicates statuses for the zone and its output.

LED	Description
	Output: lit green when the zones output is on
	Boost: lit green when the zone is in Boost mode
	Closed Loop: lit green when the zone is in a closed loop mode, such as Normal, Closed Loop Boost, Normal Soft Start, etc.

LED	Description
	Open Loop: lit green when the zone is in an open loop mode, such as Manual or Open Loop Boost
	Standby: lit green when the zone is in an standby mode or Hardware Standby mode
	Alarm: flashes red when the zone is in alarm → For more information about alarm indications, see Section 4.2.

3.2.2 Button Functions

Buttons provide access to all controller functions[3]. The purposes of the buttons are shown below.

Button	Description
Zone	Select one zone or all zones
Mute	Silence alarms for a configurable number of seconds
Boost	Boost all zones
Idle	Press briefly to put all idle zones in run state; press at least two seonds to put all zones in idle

Button	Description
Increase	Increase setpoint for the selected zone(s) and change parameter values
Decrease	Decrease setpoint for the selected zone(s) and change parameter values
Mode	Change the mode for the selected zone(s) and step through menu tems
Menu	Brief press to display modes of all zones; longer presses to enter menu system and then brief press to step through menus

[3] The Superv [Supervisor] Config menu can be used to disable the Boost and mode buttons, and to prevent operators from changing the setpoint or configuration parameter values.

3.3 Selecting One or All Zones

To select one zone, press Z repeatedly until only that zones PV and SP are displayed.

To select all zones, press Z repeatedly until the PV and SP for all zones are displayed with asterisks between the PV and SP for zones 3 and 4 (see right) on an iB6, and between zones 3 and 4, and zones 9 and 10 on an iB12.

3.4 Mode of Operation

3.4.1 Viewing Current Mode

The current mode of all zones and their output percentages can be displayed by briefly pressing the menu-access/exit button. Mode indicators and their meanings are listed in the next subsection.

3.4.2 Mode Indicators

In addition to indicators for the selectable modes (see 3.4.3 and 3.4.4), additional mode indicators are displayed under special circumstances, such as when Autotune or soft start is active.

The mode indicators are:

HSB	Hardware standby (external signal put whole controller on standby)
NRM	Normal (closed loop)
NTU	Normal auto tuning (Autotuning in process)
NSS	Normal soft start—Gradual warming if the process value is less than the lower of the setpoint or 93 °C (200 °F)
NRB	Normal mode boost (using configured boost setpoint)
MAN	Manual (open loop)
MAB	Manual mode boost (using configured boost percentage)
SBY	Standby (using configured standby setpoint in Normal mode or fixed output percent in Manual mode)
SSS	Standby soft start—If zone is set to start up in Standby, it will gradually warm to the Standby setpoint if process value is less than the lower of the Standby setpoint or 93 °C (200 °F).
IDL	Idle (no output)
FSF	Failsafe (in state configured using Superv [Supervisor] menu)
OFF	Offline (unused zone)

3.4.3 Changing Mode

To change mode of operation:

1) Select one zone or all zones as described above.
2) Access the mode-selection function by pressing .
3) Step through the selectable modes (refer to section 3.4.4) by pressing the button repeatedly until the mode you want is displayed.
4) Confirm the selection and exit the mode-selection function by pressing . A confirmation message will be displayed briefly, and then the normal operating display returns.

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3.4.4 Modes Available for Selection

The modes available for selection are:

Normal Zone uses closed-loop PID automatic control based on the entered SP and measured PV

Standby Zone uses Standby Setpoint or Standby Percentage as configured using the Control Config menu

Manual Zone uses open-loop control; you set output percentage

Boost For the configured Boost Duration time, the zone uses the Boost Setpoint or Boost Percentage configured with Boost Config menu.

Idle Zones output is off until another mode is selected using the front panel

OR — ⏻ is pressed to put all Idle zones in the Run state

Offline Zones output is off and PV is not monitored by the controller

3.5 Changing the Setpoint

To change Normal mode (closed loop) setpoint or Manual mode (open loop) output percentage:

1) Select a zone or, if all zones are in the same mode (Normal or Manual), select all zones as described in subsection 3.2.
2) Press ▲ or ▼ to change the setpoint or output percent.[4] A few seconds after you stop pressing an arrow button, the main display (PV and SP) will return.

3.6 Changing a Configuration Parameter Value

To view and change parameter values:

1) Select one zone or all zones as described in subsection 3.2.
2) Press and hold ↻ to enter the menu system.
3) Step through the menus by pressing ↻ repeatedly until the name of the menu you want is displayed. Notice that if you selected all zones before entering the menu system (or if the parameter, such as Display Units, applies to all zones), an asterisk ∗ is displayed instead of a zone number. This asterisk indicates that the change will apply to all zones.
4) Step through the menu items by pressing ☰ until the parameter you want is displayed, alternating with its current value.
5) Change the value by pressing ▲ or ▼. When changing a numerical value, you can hold down an arrow button for fast changes.

To change the value of this parameter for a different zone, press Z repeatedly until the number of the zone you want is displayed.

To change a different parameter for the selected zone, repeat steps 3 through 5 as needed.

To leave the menu system, press and hold ↻ for several seconds.

[4] The Superv [Supervisor] Config menu can be used to disable the boost and mode buttons, and to prevent operators from changing the setpoint or configuration parameter values.

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3.7 Configuration Menus and Factory Settings

The table below shows all configuration menus, the parameters in each menu, and the factory settings. Information about each parameter is in Section 5.

At the factory, all zones settings are identical.

When a parameter is accessed, the display of its name alternates with the display of its current value.

Menu	Parameters	Factory Setting
Input Config	Bias	0°
	Low Setpoint Limit	0 °C (32 °F)
	High Setpoint Limit	537 °C (999 °F)
	Input Type	Depends on input type specified when the unit was ordered
Boost Config	Boost Type (applies only to zones running in Normal mode; zones running in Manual mode always use Boost Percentage; see below)	Closed loop
	Boost Duration	Boost Off
	Boost Setpoint	25 °C (77 °F)
	Boost Percentage	0
Control Config	Standby Type	Open Loop
	Standby Setpoint	25 °C (77 °F)
	Standby Percentage	0
	Proportional Band	24
	Derivative (PID rate)	7 seconds
	PID Autotune (when it will be performed)	Once at next power-up, and then disabled, even if tuning was not successful
	Startup Mode (when zone is taken out of Idle with run/idle button ⏻)	Last Active Mode (most recent operating mode)

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Menu	Parameters	Factory Setting
Display Config	Display Units	°C [6]
Alarm Config	Inhibit Seconds	0 (off)
	High Dev Setpoint [High Deviation]	17 °C (30 °F)
	Low Dev Setpoint [Low Deviation]	17 °C (30 °F)
	Alarm Silence Seconds	120 seconds—applies to all zones
Superv. Config [Supervisor]	Set Superv. Password	100 = OFF (password protection disabled) - applies to all zones
	Fail Safe Action	Auto Average (use a calculated output value based on output values that have typically successfully maintained the current setpoint for your process in the past; if no history of Normal mode operation, then output is set to zero) - applies to selected zone
	Low Reading	Not applicable
	High Reading	Not applicable
	High [Temperature] Safety [Limit]	OFF - applies to selected zone
	Fail Safe FOP [Fixed Output Percent]	0 % - applies to selected zone
	Loop Break Time	300 seconds - applies to selected zone
	Soft Start (CompuStep® gradual warming)	Enable - applies to all zones that are in Normal (closed loop) mode
	Mode Key Enable	Enable - applies to all zones
	Boost Key Enable	Enable - applies to all zones
	SP [Setpoint] Change Enable	Enable - applies to all zones
	Config. Enable	Enable - applies to all zones
	Reset PID Parameters	No - applies to selected zone
	Load Defaults	No - applies to selected zone (but all zones must be in Idle; changes take effect after power has been cycled)

[6] Supplied as °F if sold in USA or when requested at time of purchase

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4.1 Types of Alarms

The iB6 and iB12 Temperature Controllers support high and low deviation alarms, configurable separately for each zone (see subsection 5.6). The unit also recognises process problems (such as loop break, reversed and open sensors, and process temperature exceeding configured safety limit) and problems with its own operation.

4.2 Alarm Indication

When a zone is in alarm:

- its red alarm LED flashes rapidly (Slow flashes mean an alarm was detected, but the problem does not affect operation now. For example, a zones red alarm LED flashes slowly if an open thermocouple is detected, but the zone is operating in Manual mode (in which no sensor value is used by the controller to calculate the output)
- the alarm relay closes
- a code for the type of alarm alternates with display of the setpoint (Normal mode or other closed-loop mode such as closed-loop boost) or output percentage (Manual mode or other open-loop mode such as open-loop standby); and
- unit beeps until the alarm condition is cleared or the zone is put in Idle mode or the alarm is silenced (refer to Section 4.3 below).

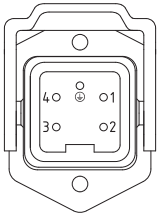
4.3 Silencing Alarm Beep

You can temporarily silence the alarm beep by pressing the alarm silence button. Beeping will be silenced for the configured number of seconds. (The default is 120 seconds.)

4.4 External Indication

An output on the back of the controller allows external devices (such as horns or lights) to be connected to the controller for alarm annunciation. For more information about this feature, see the diagrams shipped with the controller.

This alarm output is not affected when the alarm silence button on the front of the controller is pressed.



Pin	Connection
1	Alarm Common
2	Alarm N.O.
3	Standby Switch
4	Standby Switch
⏚	Ground

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4.5 Alarm Priorities

If a zone has more than one alarm condition, the code for the highest-priority alarm is displayed. Alarm priorities are in the table below.

Priority	Code	Condition	Controller Response	How Alarm Is Cleared
1	OVt	Internal over-temperature	All outputs off	Turn off controller; make sure fan and vents are not blocked; wait for controller to cool; turn on controller; if error recurs, contact technical support
2	ER1 or ER2	Problem with controller's internal operation	All outputs off	Cycle power to controller; if error recurs, contact the Mastip technical support at **mastip@mastip.com** or your local distributor
3	TCr	Reversed thermocouple detected	Zone goes to configured failsafe state	Use ☰ button to put the zone in Idle as described in 3.4.3, and then after problem is fixed, put zone in Normal (closed loop) or Manual (open loop) mode
4	SAF	High-temperature safety limit exceeded (configured in Superv. Config menu; default is feature disabled)	Zone output off if feature is enabled	
5	TCo	Open thermocouple detected	Zone goes to configured failsafe state (configured in Superv. Config menu)	
6	LPB	Loop break detected	Zone output off	
7	HID	High deviation alarm	Zone output off	Clears automatically when alarm condition clears
8	LOD	Low deviation alarm	Zone output on	
9	Tu0 Tu3 Tu5 Tu8 Tu9	Autotuning error	Zone output off	Use ☰ button to put the zone in Idle as described in 3.4.3, and then after problem is fixed, try tuning again → For more information about tuning and Autotuning errors, see Section 6.

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5.1 Introduction

This section contains information about every configuration parameter, including valid ranges, control mode(s) to which the parameter applies and interactions among parameters.

→ For an overview of configuration menus and parameters refer to Section 3.7.

5.2 Input Parameters

5.2.1 Introduction

You can use the Input Config menu to specify for the selected zone(s):

- bias (if any) to be applied to the input,
- setpoint range, and
- input type

5.2.2 Input Parameters and Settings

Name	Applies to				Range/ Choices	Default	Description & Interactions
	Selected Zones	All Zones	Closed Loop Control	Open Loop Control			
Bias	✓		✓	✓	–55 to 55 °C –100 to 100 °F	0°	Number of degrees that will be added to or subtracted from the measured process value before it is displayed
Low Setpoint Limit	✓		✓		0 to 537 °C 32 to 999 °F	0 °C 32 °F	Lowest and highest values that can be entered as setpoint (before bias is applied); also limits configurable range of boost setpoint and standby setpoint
High Setpoint Limit	✓		✓		0 to 537 °C 32 to 999 °F	537 °C 999 °F	
Input Type		✓	✓	✓	J Thermo K Thermo	Input type specified when unit was ordered	Switching to input type that does not match the type specified when the unit was ordered can cause small errors (1-5 degrees) in temperature measurements

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5.3 Boost Parameters

5.3.1 Introduction

A boost button ⎍ s on the iB6 and iB12 front panel. When you press ⎍, the output of a zones will be increased temporarily.

You can use the Boost Config menu to specify:

- whether the boost function will be closed loop (based on a setpoint) or open loop (based on a specified output percent)
- boost setpoint and duration for closed loop boost
- boost output percentage and duration for open loop boost

5.3.2 Boost Parameters and Settings

Name	Applies to				Range/ Choices	Default	Description & Interactions
	Selected Zones	All Zones	Closed Loop Control	Open Loop Control			
Boost Type		✓	✓		Open Loop Closed Loop	Closed Loop	Type of control used after ⎍ is pressed; applies only to zones running in Normal mode; zones running in Manual mode always use Closed Loop boost
Boost Duration	✓		✓	✓	Boost Off 15 seconds 30 seconds 45 seconds 60 seconds 75 seconds 90 seconds 105 seconds 120 seconds	Boost Off	Length of boost
Boost Setpoint	✓		✓		Low Setpoint Limit to High Setpoint Limit (from Input Config menu)	25 °C 77 °F	Setpoint used in Closed Loop boost
Boost Percentage	✓			✓	0 to 100%	0 (off)	Output percent used in Open Loop boost

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5.4 Control Parameters

5.4.1 Introduction

You can use the Control Config menu to specify how the selected zone(s) will be controlled:

- at startup (after you have pressed the run/idle button to take the controller out of Idle),
- during Normal operation,
- when the button has been used to put the zone in Standby or when a zone configured to start up in Standby mode comes out of Idle, and
- when an external signal has been used to put the whole controller in Hardware Standby.

The Control Config menu is also used to specify whether and how often Autotuning (described in Section 6) is done.

5.4.2 Control Parameters and Settings

Name	Applies to				Range/ Choices	Default	Description & Interactions
	Selected Zones	All Zones	Closed Loop Control	Open Loop Control			
Standby Type	✓		✓	✓	Open Loop Closed Loop	Open Loop	Type of control used while the controller's front panel buttons have been used to put the selected zone(s) in standby mode: closed loop (Standby Setpoint used) or open loop (Standby Percentage used) Note: When an external signal puts all zones in Hardware Standby mode, this Standby Type value is ignored. If a zone is closed-loop when the Hardware Standby signal is received, the configured Standby Setpoint is used. If a zone is open-loop when the Hardware Standby signal is received, the configured Standby Percentage is used.
Standby Setpoint	✓		✓		Low Setpoint Limit to High Setpoint Limit (from Input Config menu)	25 °C 77 °F	Setpoint used when zone is in closed loop standby mode

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Name	Applies to				Range/ Choices	Default	Description & Interactions
	Selected Zones	All Zones	Closed Loop Control	Open Loop Control			
Standby Percentage	✓			✓	0 to 100 %	Zero	Output percent used when zone is in open loop standby mode
Proportional Band	✓		✓		1 to 537 °C 1 to 999 °F	13 °C 24 °F	Width of the band below the setpoint within which the controller will modulate the output as the process value approaches the setpoint; **Autotuning sets this value automatically**; Refer to Section 6
Derivative (rate)	✓		✓		0.0 to 999 seconds	7 seconds	Time period used by the derivative component of the control algorithm when analyzing load changes; **Autotuning sets this value automatically**; Refer to Section 6 The integral action for PID control is not configurable; the integral (reset) action is always equal to six times the configured derivative (rate) action.
PID Autotune	✓		✓		**Disable** **Once** (then disabled after successful Autotune) **Enable** (Autotunes every time controller is powered up) **One Try Only** (and then disabled, even if Autotune was not successful)	One Try Only	Whether and when Autotune should be done

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Name	Applies to				Range/ Choices	Default	Description & Interactions
	Selected Zones	All Zones	Closed Loop Control	Open Loop Control			
Startup Mode	✓		✓	✓	**Auto** (Normal closed loop) **Standby** **Manual** (open loop) **Idle** (remains in Idle after ⏻ is pushed to set controller to Run state) **Last Active Mode** (same mode as last time controller was running)		Mode used for the zone when the controller goes from Idle to Run (because operator pushed ⏻ on the front of the case)

5.5 Display Units

5.5.1 Introduction

On the front panel the lit green LED labeled C or F indicates the units of measure for the process values and setpoints displayed.

You can use the Display Config menu to change the unit of measure used for displayed temperatures.

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5.5.2 Display Parameter and Settings

Name	Applies to				Range/ Choices	Default	Description & Interactions
	Selected Zones	All Zones	Closed Loop Control	Open Loop Control			
Display Units		✓	✓	✓	°C °F	°C [7]	Unit of measure used for all zones for all displayed temperatures, including parameter values; changing Display Units causes all temperatures already entered as parameter values or setpoints to be converted to the newly selected unit of measure when displayed

5.6 Alarm Parameters

5.6.1 Introduction

High and low deviation alarms are supported for each zone. (Section 4 contains information about alarm indication and effects on outputs.)

You can use the Alarm Config menu to specify for the selected zone(s):

- how many seconds after zone is taken out of Idle the controller should wait before indicating a low alarm (Alarm Inhibit)
- number of degrees the process value must exceed the setpoint before the zone goes into alarm (High Deviation)
- number of degrees the process value must fall short of the setpoint before the zone goes into alarm (Low Deviation)
- the number of seconds the audible alarm on the iB6 or iB12 unit will be silenced when (on the front of the controller's case) is pressed; this value applies to ALL zones in alarm.

[7] Supplied as °F if sold in USA or when requested at time of purchase

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5.6.2 Alarm Parameters and Settings

Name	Applies to				Range/ Choices	Default	Description & Interactions
	Selected Zones	All Zones	Closed Loop Control	Open Loop Control			
Inhibit Seconds	✓		✓	✓	0 to 999 seconds	0 (off)	Number of seconds the controller should wait after zone is taken out of Idle before signaling a low alarm
High Dev Setpoint	✓		✓	✓	1 to 537 °C 1 to 999 °F	17 °C 30 °F	Number of degrees the process value must exceed the setpoint to trigger the alarm state
Low Dev Setpoint	✓		✓	✓	1 to 537 °C 1 to 999 °F	17 °C 30 °F	Number of degrees the process value must fall below the setpoint to trigger the alarm state
Alarm Silence Seconds		✓	✓	✓	0 to 600 seconds	120 seconds	Number of seconds the audible alarm on the controller will be silenced when is pressed.

5.7 Supervisor Parameters

5.7.1 Introduction

You can use the Superv [Supervisor] Config menu to specify the values of several parameters related to process protection for the selected zones. You can also use this menu to set up parameters that apply to the whole controller.

The Superv Config menu can be password protected. iB6 and iB12 Temperature Controllers are shipped with the Supervisor password set to 100, which disables this feature. You can use this menu to specify a different password. Only users who know your new three-digit password will be able to view and change parameters in the Superv Config menu.

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5.7.2 Supervisor Parameters and Settings

Name	Applies to				Range/ Choices	Default	Description & Interactions
	Selected Zones	All Zones	Closed Loop Control	Open Loop Control			
Set Superv. Password		✓	✓	✓	100 to 999	100 = Off	Password needed to access parameters in Superv [Supervisor] Config menu
Fail Safe Action	✓		✓	✓	Off Auto Average Fixed Output Pct.	Auto Average	Output action to be used when controller detects an open or reversed sensor: off, automatically calculated based on past good output values (if no history of Normal mode output values, then zero), or failsafe fixed output percent
Low Reading	✓		✓	✓	—	—	Lowest process value for selected zone since the last time the reading was reset by pressing the up or down arrow button
High Reading	✓		✓	✓	—	—	Highest process value for selected zone since the last time the reading was reset by pressing the up or down arrow button
High Safety (High Temperature Safety Limit)	✓		✓	✓	1 to 537 °C 33 to 999 °F	OFF	Output will be turned off if process value reaches this temperature
Fail Safe FOP (fixed output percentage)	✓		✓		0 to 100%	0%	Output percent used only if open or reversed sensor is detected and Fail Safe Action is set to Fixed Output Pct.
Loop Break Time (sec.)	✓		✓	✓	OFF 10 to 999 seconds	300 seconds	Time period during which the input should change 1% of supported sensor span (5.37 °C or 9.67 °F) in response to output action if the sensor is working correctly and the input wiring is intact

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5.7.2 Supervisor Parameters and Settings

Name	Applies to				Range/ Choices	Default	Description & Interactions
	Selected Zones	All Zones	Closed Loop Control	Open Loop Control			
Soft Start	✓		✓		Disable Enable	Enable	Gradual increase of output to slowly dissipate moisture in heaters; refer to 1.2.3
Mode Key Enable		✓	✓	✓	Disable Enable	Enable	Enables/disables ☰ button
Boost Key Enable		✓	✓	✓	Disable Enable	Enable	Enables/disables Z button
SP Change Enable		✓	✓	✓	Disable Enable	Enable	Enables/disables use of front panel buttons to change Normal mode setpoint and Manual mode output percentage
Config. Enable		✓	✓	✓	Disable Enable	Enable	Enables/disables use of front panel buttons to change configuration parameter values
Reset PID Parameters	✓		✓		Yes No	No	Return tuning parameters to their default settings, undoing Autotuning or manual tuning
Load Defaults	✓		✓	✓	Yes No	No	Return configuration parameter values to their default settings as described in Section 8.0

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6.1 Introduction

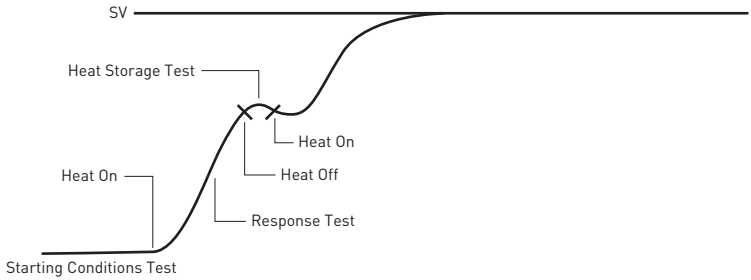
iB6 and iB12 Temperature Controllers support automatic tuning for control of zones running in CompuCycle Normal (closed loop) mode.

By default, every iB6 and iB12 controller is configured to execute the Autotune operation the first time it is powered up, **then to disable the Autotune feature, even if Autotune was not successful.**

The Autotune operation overwrites any existing proportional band and derivative (rate) parameter values that were previously configured.

All iB6 and iB12 controllers in a single process should be Autotuned simultaneously, so that interactions between zones during tuning parallel the interactions expected while the controllers are in use.

Typical Autotune PV Profile



6.2 Procedure for Autotuning

To Autotune:

1) Make sure the controller is in Idle state (only the green C or F LED lit).
2) After configuring any parameters that you want to change from the defaults, enter a setpoint that is representative of the setpoint you expect to use when the selected zones are in Normal mode operation.
3) If Autotuning has been attempted in the past, the Autotune feature may be disabled. To force an Autotune operation, use the Control Config menu to set the PID Autotune parameter to Enable.
4) Cycle the power to the controller.
5) At this point the controller may execute a CompuStep® soft start.
    - If you want the soft start to continue to its normal conclusion (recommended), do not press any buttons.
    - If you want to terminate the soft start (not recommended), use the mode button ☰ to set the selected zones mode to Normal.

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During the Autotune operation, the display for the selected zones blinks "Tun." **Unless you want to terminate the Autotune by changing a zones mode, do not press any buttons during the Autotune operation.** The lower line will continue to display the setpoint you entered in Step 2.

When the controller has completed Autotuning a zone successfully, the controller will save the tuning parameter values in the Proportional Band and Derivative (rate) parameters for all zones that have Autotuned successfully. (The new tuning values can be viewed using the Control Config menu.)

If Autotune was unsuccessful for a zone, the zone will:

- use default values for PID parameters,
- go into alarm (red LED lit in the row),
- display its process value alternating with one of the tuning error codes listed in 6.3, and
- go to configured failsafe state; the effect on a zones output depends on how you configured the Fail Safe Action parameter in the Superv [Supervisor] Config menu.

To clear the error display and put the zone(s) in standby mode, use the mode button . (The effect on each zones output depends on the standby configuration selections you made using the Control Config menu.)

Fix the problem (see error code meanings in next subsection) and try tuning again.

Once Autotune has been completed successfully for all Normal zones ("NRM" mode displayed) use the Control Config menu to disable PID Autotune.

6.3 Autotune Errors

The Autotune error codes are in the table below.

Error Code	Description
Tu3	Setpoint is lower than the process value. Look at the setpoint. If it is realistic for your process, then check the thermocouple leads; maybe they are reversed.
Tu5	The initial process value and the setpoint are not far enough apart. For Autotune to work, the difference must be at least 5 °C (9 °F).
Tu8	The startup curve (change in PV) was not acceptable to the Autotune algorithm. This problem could be caused by a process upset that occurred during tuning. Try Autotuning again when the process is stable. If the error recurs, your process is not suitable for Autotuning. Use manual tuning as described in 6.4.
Tu9	The Autotuning timed out, because the process was unresponsive (or extremely slow to respond). Your process is not suitable for Autotuning. Tune the controller manually as described in 6.4.
Tun0	The Autotune operation failed for a reason other than those listed above. Try Autotuning again when the process is stable.

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6.4 Manual Tuning (Zeigler-Nichols PID Method)

6.4.1 Introduction

This tuning method may be used if the spread between initial process temperature and process operating temperature is small, or if the process is too slow for Autotuning. Manual tuning requires that zones be tuned one at a time and that the PV be tracked over time. (Graph the displayed PV against time manually.) All zones should be running while manually tuning one zone.

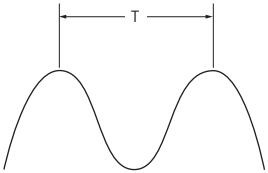
After you have finished manual tuning, you can change the Startup Mode parameter setting and enable soft start (recommended).

6.4.2 Procedure

To do manual tuning:

1) After configuring any parameters that apply to your control strategy, enter a setpoint that is representative of the setpoint you expect to use when the selected zone is in Normal operation.
2) Go to the Control Config menu.
3) For now, leave the Proportional Band set to 13 °C (24 °F), but change the Derivative (PID rate) to 0 seconds.
4) In the Control Config menu, set the PID Autotune parameter to Disable.
5) Return to the standard operating display and watch the behavior of the displayed process value. When the temperature reaches setpoint, plot a graph of the displayed process value against time or record the time period between temperature peaks. (Be patient. It may be several minutes before you see up and down changes (oscillation) in the process value for a manifold zone.)
6) If the temperature (process value) will not oscillate, then decrease the proportional band value by repeatedly halving the value (dividing it by 2) until a small, sustained temperature oscillation is seen.

   Alternatively, if the temperature (process value) oscillates severely, double the proportional band value (multiple it by 2) repeatedly until a small, sustained temperature oscillation is observed.
7) Measure the period in seconds of one cycle of oscillation ("T" on the diagram below).



8) Divide the period of oscillation (T) by 8. The resulting number (quotient) is the correct Derivative parameter value (rate) time in seconds.
9) Access the Control Config menu and enter the Derivative value obtained in Step 8. The integral time will be set automatically to 6 times the rate. (You cannot view the integral term value.)
10) If the process is stable, manual tuning is completed. However, if slight oscillation is observed, multiply the current proportional band value by 1.66 and enter the product as the new PID Proportional Band value to complete the tuning procedure for this zone.

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7.1 Introduction

If you have access to the Superv [Supervisor] Config menu, you can disable any of the following: the soft start feature (not recommended), boost button, mode button, use of the front-panel buttons to change setpoints or configuration parameters.

7.2 Procedure

To disable/enable a button or function:

1) Select any zone by pressing Z.
2) Access the menu system by pressing until a menu name is displayed, and then press repeatedly until the name of the Superv Config menu is displayed.
3) Step through the parameters by pressing repeatedly until the name of the function you want to disable is displayed.
4) Choose "Disable" or "Enable" by pressing or .
5) Exit the menu system by pressing and holding until the standard operating display (PV and SP) is displayed.

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8.1 Introduction

Using this function returns all configuration parameter values for the selected zone(s) to their defaults (shown in Section 5). The setpoints for the selected zone(s) will be changed to 25 °C (77 °F).

Reloading defaults never affects the following settings that apply to the whole controller: display units, input type. These settings that apply to the whole controller are not reset, even if all zones are selected before loading defaults.

When all zones have been selected for resetting defaults, some settings that apply to the whole controller WILL be reset to the defaults shown in shown in Section 5. These values that are returned to the defaults include the Supervisor password (which will be reset to 100, disabling password protection) and access control settings described in Section 7.

After loading defaults, you will need to cycle power to the controller before you can resume operation.

8.2 Procedure

To load defaults to selected zones:

1) Put the controller in the Idle state by pressing ⏻ for at least two seconds. (When the whole controller is in the Idle state, only the green C or F LED will be lit.)
2) Select the zone for which you want to load defaults by pressing Z until only that zones SP and PV are displayed. Alternatively, select all zones by pressing Z until all zones SP and PV are displayed with asterisks ** between the values for zones 3 and 4 (iB6), or between 3 and 4, and 9 and 10 (iB12).
3) Access the menu system by pressing ↩ until a menu name is displayed, and then press ↩ repeatedly until the name of the Superv Config menu is displayed.
4) Step through the parameters by pressing ☰ repeatedly until Load Defaults is displayed.
5) Choose "Yes" by pressing ▲ or ▼.
6) Exit the menu system by pressing and holding ↩ until "Power Cycle the System" is displayed.
7) Cycle power to the controller. When powered up, the controller will use the default settings for the zone(s) selected in step 2.

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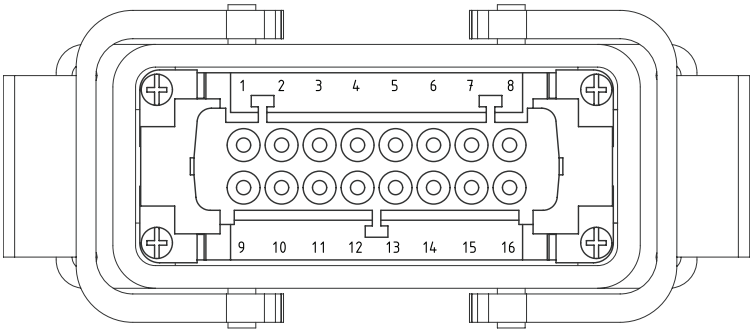
9.1 CE 16 Pin Female Power Connector for iB6



6 Zone, 16 Pin Mould Connector		
Zone	Pin Number	Connection
1	1	Power
	9	Return
2	2	Power
	10	Return
3	3	Power
	11	Return
4	4	Power
	12	Return
5	5	Power
	13	Return
6	6	Power
	14	Return
	⏚	Ground

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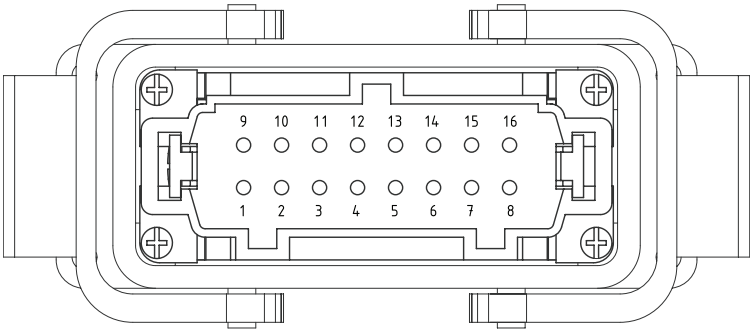
9.2 CE 16 Pin Male Thermocouple for iB6



6 Zone, 16 Pin Mould Connector		
Zone	Pin Number	Connection
1	1	Thermcouple +
	9	Thermcouple -
2	2	Thermcouple +
	10	Thermcouple -
3	3	Thermcouple +
	11	Thermcouple -
4	4	Thermcouple +
	12	Thermcouple -
5	5	Thermcouple +
	13	Thermcouple -
6	6	Thermcouple +
	14	Thermcouple -
	⏚	Ground

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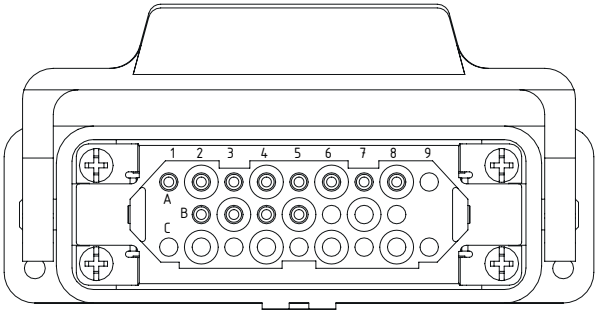
9.3 US Domestic 25 Pin Female Power Connector 10A Max for iB6



6 Zone, 25 Pin Mould Connector		
Zone	Pin Number	Connection
1	A1	Power
	A2	Return
2	A3	Power
	A4	Return
3	A5	Power
	A6	Return
4	A7	Power
	A8	Return
5	B2	Power
	B3	Return
6	B4	Power
	B5	Return
	⏚	Ground

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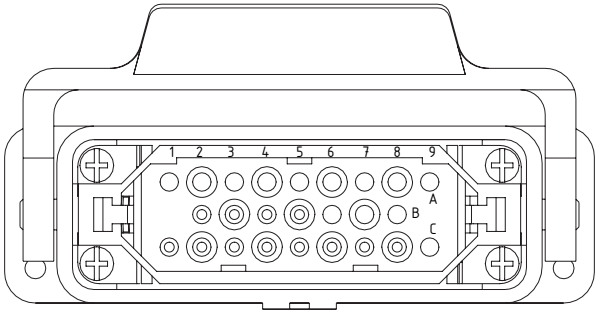
9.4 US Domestic 25 Pin Male Thermocouple Connector for iB6



6 Zone, 25 Pin Mould Connector		
Zone	Pin Number	Connection
1	A1	Thermocouple +
	A2	Thermocouple -
2	A3	Thermocouple +
	A4	Thermocouple -
3	A5	Thermocouple +
	A6	Thermocouple -
4	A7	Thermocouple +
	A8	Thermocouple -
5	B2	Thermocouple +
	B3	Thermocouple -
6	B4	Thermocouple +
	B5	Thermocouple -
	⏚	Ground

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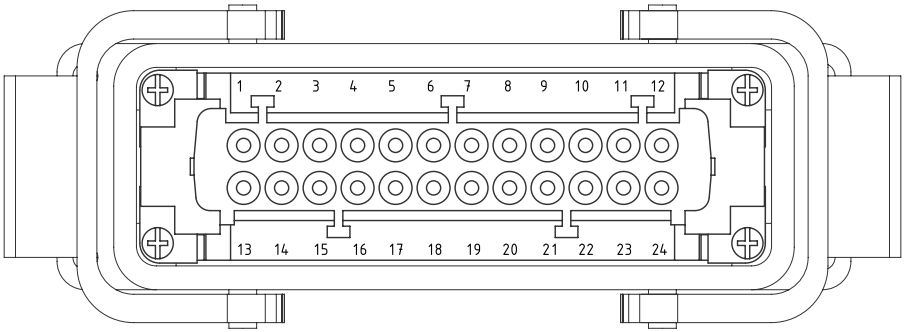
9.5 CE 24 Pin Female Power Connector for iB12



12 Zone, 24 Pin Mould Connector		
Zone	Pin Number	Connection
1	1	Power
	13	Return
2	2	Power
	14	Return
3	3	Power
	15	Return
4	4	Power
	16	Return
5	5	Power
	17	Return
6	6	Power
	18	Return
7	7	Power
	19	Return
8	8	Power
	20	Return
9	9	Power
	21	Return
10	10	Power
	22	Return
11	11	Power
	23	Return
12	12	Power
	24	Return
	⏚	Ground

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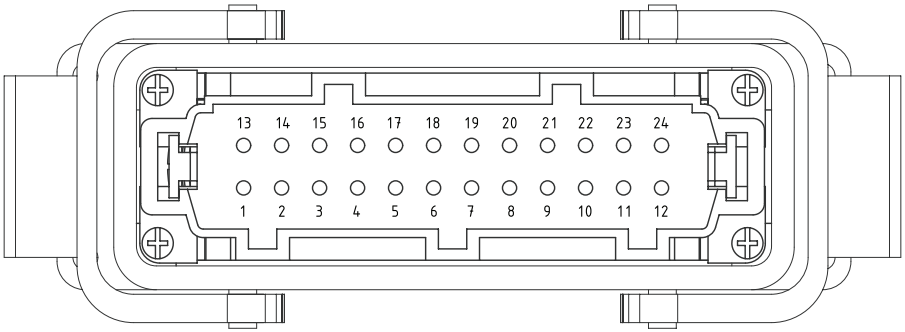
9.6 CE 24 Pin Male Thermocouple Connector for iB12



12 Zone, 24 Pin Mould Connector		
Zone	Pin Number	Connection
1	1	Thermocouple +
	13	Thermocouple -
2	2	Thermocouple +
	14	Thermocouple -
3	3	Thermocouple +
	15	Thermocouple -
4	4	Thermocouple +
	16	Thermocouple -
5	5	Thermocouple +
	17	Thermocouple -
6	6	Thermocouple +
	18	Thermocouple -
7	7	Thermocouple +
	19	Thermocouple -
8	8	Thermocouple +
	20	Thermocouple -
9	9	Thermocouple +
	21	Thermocouple -
10	10	Thermocouple +
	22	Thermocouple -
11	11	Thermocouple +
	23	Thermocouple -
12	12	Thermocouple +
	24	Thermocouple -
	⏚	Ground

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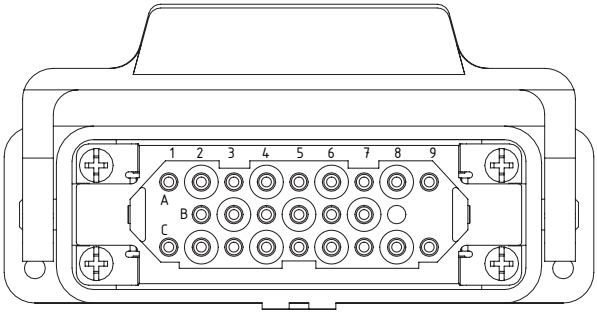
9.7 US Domestic 25 Pin Female Power Connector 10A Max for iB12



12 Zone, 25 Pin Mould Connector		
Zone	Pin Number	Connection
1	A1	Power
	A2	Return
2	A3	Power
	A4	Return
3	A5	Power
	A6	Return
4	A7	Power
	A8	Return
5	B2	Power
	B3	Return
6	B4	Power
	B5	Return
7	B6	Power
	B7	Return
8	C1	Power
	C2	Power
9	C3	Power
	C4	Return
10	C5	Power
	C6	Return
11	C7	Power
	C8	Return
12	A9	Power
	C9	Return
	⏚	Ground

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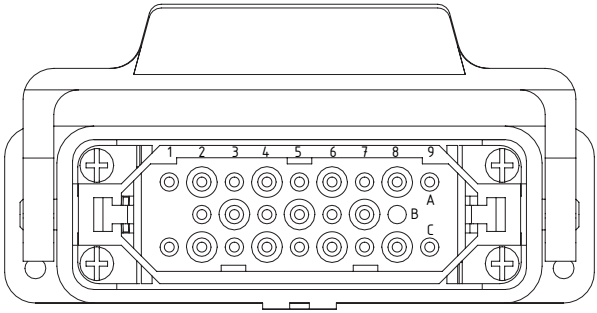
9.8 US Domestic 25 Pin Male Thermocouple Connector for iB12



12 Zone, 25 Pin Mould Connector		
Zone	Pin Number	Connection
1	A1	Thermocouple +
	A2	Thermocouple -
2	A3	Thermocouple +
	A4	Thermocouple -
3	A5	Thermocouple +
	A6	Thermocouple -
4	A7	Thermocouple +
	A8	Thermocouple -
5	B2	Thermocouple +
	B3	Thermocouple -
6	B4	Thermocouple +
	B5	Thermocouple -
7	B6	Thermocouple +
	B7	Thermocouple -
8	C1	Thermocouple +
	C2	Thermocouple -
9	C3	Thermocouple +
	C4	Thermocouple -
10	C5	Thermocouple +
	C6	Thermocouple -
11	C7	Thermocouple +
	C8	Thermocouple -
12	A9	Thermocouple +
	C9	Thermocouple -
	⏚	Ground

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